Radial Approach in the Treatment of Supraaortic Arterial Lesions

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Summary

Radial approach (mainly right) has been used in the treatment of 67 supraaortic lesions including 56 carotid, nine vertebral and two subclavian artery stenoses. This approach offers new possibilities and solves most of the remaining technical difficulties or impossibilities encountered in the endovascular treatment of supraaortic lesions. The current technique is described. The results of this first series have been very satisfactory without complication. MR angiography allows selection of patients suitable for radial approach.

Introduction

It has become evident that, in the near future, the endovascular approach will play an important role in the treatment of supraaortic arterial pathology. The most commonly encountered lesions are atherosclerotic stenoses at the carotid bifurcation. After the pioneering work of Mathias [1], we have contributed to improving both procedural and long-term outcome of endovascular treatment of carotid stenoses by cerebral protection [2-5] and carotid stenting [6]. These improvements have made it possible to consider using an endovascular approach for almost all stenoses at the carotid bifurcation.

However, in our experience, one of the major remaining limitations are the difficulties encountered in the catheterization of the supraaortic arteries in patients in whom the femoral approach is difficult or impossible due to severe peripheral vascular disease or to the presence of tortuous supraaortic arteries. The radial artery approach (figure 1), now in widespread use by cardiologists [7-10], has only rarely been used in the supraaortic field for diagnosis [11-13] and even less for interventional procedures [14-16]. We previously reported our early experience [17]. This paper presents our current experience on the treatment of 67 interventional supraaortic lesions where this promising approach has been used.

Material

Sixty-seven supraaortic lesions were treated in 63 patients. The lesions were located on the carotid artery on 56 cases, the vertebral artery in nine cases, and the subclavian artery in two cases. A right radial approach was used in 61 cases, a left radial approach in two cases. In four cases more than one artery was treated in the course of the same procedure: one carotid and two vertebral arteries (one case), one carotid and one vertebral arteries (two cases), two carotid arteries (one case). There were 37 males and 26 females ranging from 42 to 87-year-old (mean 62 years).

The carotid artery lesions included two innominate artery atherosclerotic stenoses (figure 2), two common artery stenoses (one atherosclerotic stenosis, one post surgical dissection with stroke) (figure 3), 49 atherosclerotic inter-

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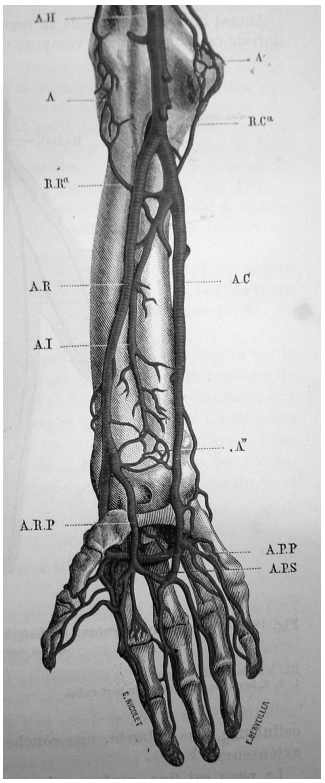

Figure 1 A-D) Radial approach. A) Anatomical drawing of the forearm arteries. B) Favorable pattern of the brachial artery bifurcation with a straight radial artery of good diameter. C) Small and tortuous origin of the radial artery. This pattern is compatible with a small 5 french diagnostic catheterization but excludes a 7 french therapeutic catheterization. D) Arterial loop of the radial artery origin that excludes this approach. A cubital approach remains possible.

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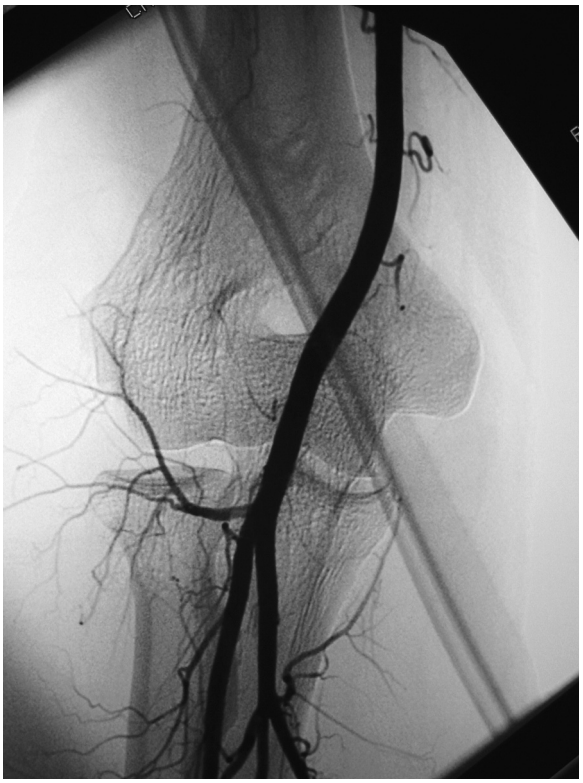

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nal carotid stenoses at the bifurcation (figure 4) (26 on the right side, 23 on the left side), one atherosclerotic right internal carotid occlusion at the bifurcation, one left post endarterectomy restenosis and one post radiotherapy stenosis (figure 5).

The subclavian artery stenoses were atherosclerotic in one case on the left side and dysplastic in one case on the right side with dissection and associated aneurysm treated by coiling in the same session. Both cases were approached from the right radial artery.

The vertebral artery stenoses were on the right side in six cases and on the left side in three. The left side stenoses were isolated in two cases and treated from a left radial approach. In one case the left vertebral artery stenosis was associated with a carotid artery stenosis and was treated in the same session from a right radial approach.

In another seven cases the procedure was not attempted or was abandoned for the following reasons: in three cases the radial approach was not attempted because the hand collateral circulation was not satisfactory (Allen test), in two cases at the beginning of our experience, the procedure was aban-

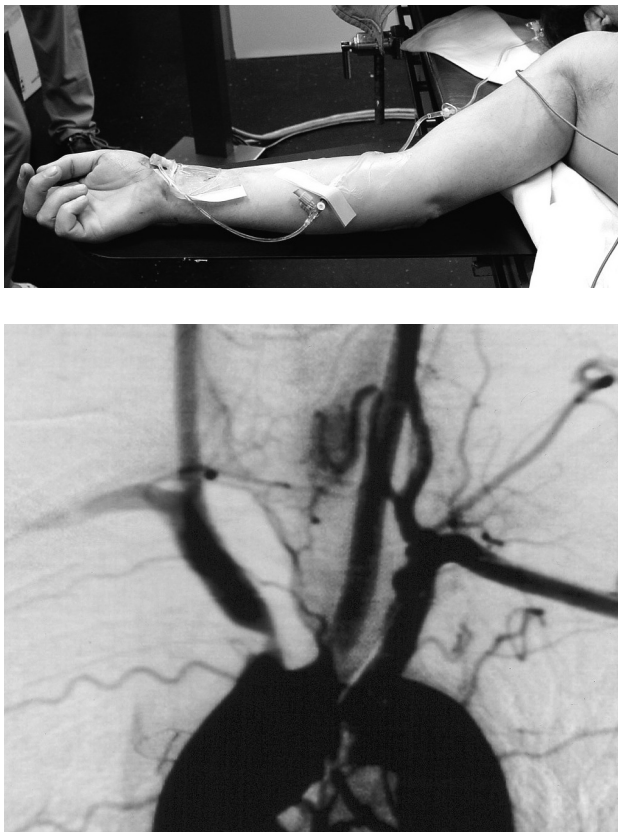
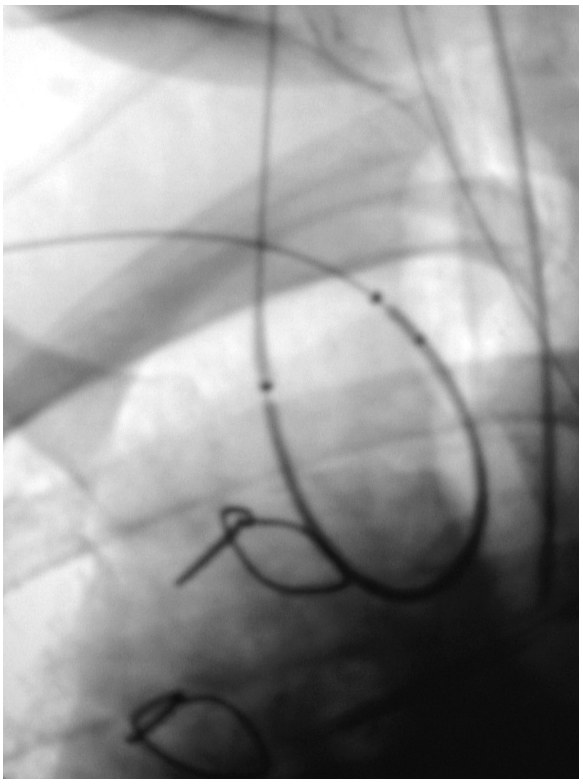


Figure 2 A-D) Radial approach in the treatment of the origin of neck vessels. Case 1: atherosclerotic narrow stenosis of the innominate artery. 46-year-old patient, heavy smoker, multiple occlusions of the iliac and legs arteries. A) A 8 french introducer is positioned in the right radial artery. B) Pretherapeutic aortic arch angiogram. Narrow stenosis of the Innominate artery. Note the thoracic collateral circulation. C) A 9 mm autoexpandable stent is positioned. D) Control aortic arch angiogram. Satisfactoray innominate artery diameter. There is no longer a collateral circulation.



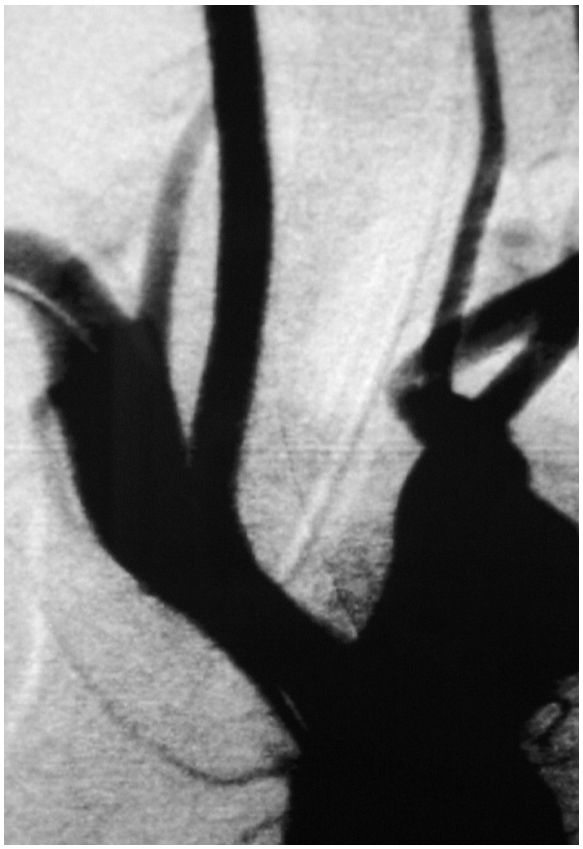


Figure 3 A-C) Radial approach in the treatment of the origin of neck vessels. Case 2: right hemispheric stroke that occurred in the immediate follow-up of surgery performed on the ascending aorta. 43-year-old patient. Catheterization from the femoral artery was unsuccessful. Right radial approach. A) Aortic arch angiogram. Dissection of the right common carotid artery. B) A stent is advanced and deployed in the common carotid artery from the radial artery. An intraarterial thrombolysis is performed. C) Aortic angiogram performed immediately after treatment. Good clinical result.

doned due to unsuccessful puncture of the radial artery, in two cases the procedure was abandoned because of anatomical variants at the brachial artery bifurcation that did not allow positioning a 7 french guiding catheter in tortuous or small brachial vessels.

Method

A) Stenting of atherosclerotic stenoses at the carotid bifurcation

Since our first attempts, we have progressively selected items better adapted to the use of the radial apppoach in this indication. Our current technique of carotid stenting is as follows:

1) The right radial artery is punctured using the Terumo kit (Introradial 5f, RM AF5J10SQW).

2) 5mg of Verapamil (Isoptine, Manidon) are injected into the radial artery. A thorough complementary injection of local anaesthetic is performed on each side of the introductor.

3) A diagnostic 5 french catheter (Terumo, Hinck, RF EJ15010M) is introduced in the radial artery.

4) The pattern of the brachial artery bifurcation is checked on fluoro or, when necessary, on an angiographic series to visualize the anatomical variants that can make the use of a 7F guiding catheter impossible. In this case a cubital approach can be considered.

5) The catheter is advanced up to the aortic arch. In a few cases the right or left common carotid artery may be catheterized directly with this catheter. However in most cases another curve is necessary.

6) The exchange wire is advanced (Cook THSF-35-260 or THSF-35-260-3) and the catheter is retrieved.

7) Simmons curve diagnostic catheter is advanced and formed in the ascending aorta (Terumo Simmons II, RF EA 25010M or Simmons III, RF EA 35010M). In very tortuous vessels a 6 french Simmons catheter (Cordis 455-661) helps significantly in the catheterization but it will be advanced after having exchanged the radial introducer (see further).

8) After having catheterized the right or left common carotid artery, the exchange wire is positioned and the diagnostic catheter is retrieved.

9) Another injection of 5 mg of Verapamil is performed in the introducer.

10) The 5 french introducer is retrieved and replaced by a 7 (sometimes 8 french) introducer.

11) A guiding catheter is advanced in the common carotid artery. Long introducers are, in our opinion, not advisable for the radial approach because they may induce spasm of the radial artrery. Regular introducers and guiding catheters are recommended. Guiding catheters with coaxial catheters are most advisable, because they help passing the origin of the artery (Cook LMNG-70C-90-ANG-HC or for the left carotid LMNG-7,OC-100-ANG-HC or for, the introduction of the 9mm carotid Wallstent, LMNG-8,O-100-ANG-HC).

12) The carotid bifurcation is mapped with an angiographic series and a road map. The carotid stenosis is passed with a soft 14 neurowire without cerebral protection.

13) The stent is advanced and positioned. We currently use rapid exchange stents (Boston scientific, Carotid Wallstent SCH-64 709 7 mm / 5 cm or SCH-64 713 9 mm / 4 cm) or over-the-wire stents (Cook, ZIV5-125-7-6.0 or ZIV5-125-8-6.0). The stent is deployed without cerebral protection. In the rare cases (less than 5%) where a predilatation is necessary to allow passage of the stent a 2 mm angioplasty ballon will be used without cerebral protection (Boston , Maverick 2 mm / 2 cm, 30275-2020).

14) The guiding catheter is advanced in the stent.

15) The delivery system and wire are retrieved.

16) The protection system is advanced into the stent. We currently use either a filter (Boston Scientific Filter-Wire EZ 20100-399) or, more preferably, a temporary balloon occlusion of the internal carotid (Medtronic GEZ62006 and currently Minvasys TwinOne).

17) The post dilatation is performed with Guidant Viatrac 14Plus 1008197-21 balloon when a filter or the Medtronic system are used. With the Minvasys TwinOne system the angioplasty ballon is included in the device.

18) At the end of the procedure control angiographic series will be performed and will need another exchange of catheter for controlling the modification of the parenchymal supply by arch injections (Digitized Parenchymography)[18].

19) The catheter is retrieved and the compression started for four hours (Terumo TR band XXRF06).

B) Stenting of non atherosclerotic stenoses

Early restenoses after carotid endarterectomy do not necessitate a cerebral protection because the lesion is a myointimal hyperplasia. Instead, late restenoses should be stented with cerebral protection because the restenosis is, at least in part, atherosclerotic. We currently also use cerebral protection in post radiation stenosis because the lesion is also in part atherosclerotic. Fibromuscular dysplasias and dissections, which are also good indications of stenting, do not necessitate cerebral protection.

C) Stenting of subclavian and vertebral arteries

In our opinion, subclavian artery stenoses do not necessitate cerebral protection. For hemodynamic reasons the Wallstent is not advisable because restenoses are rather frequent with this stent in this artery. We nevertheless

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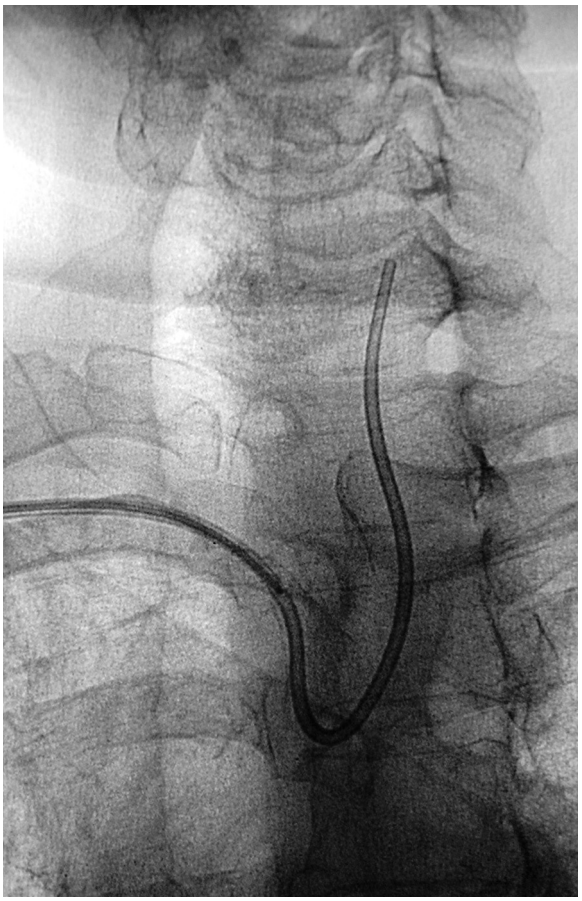

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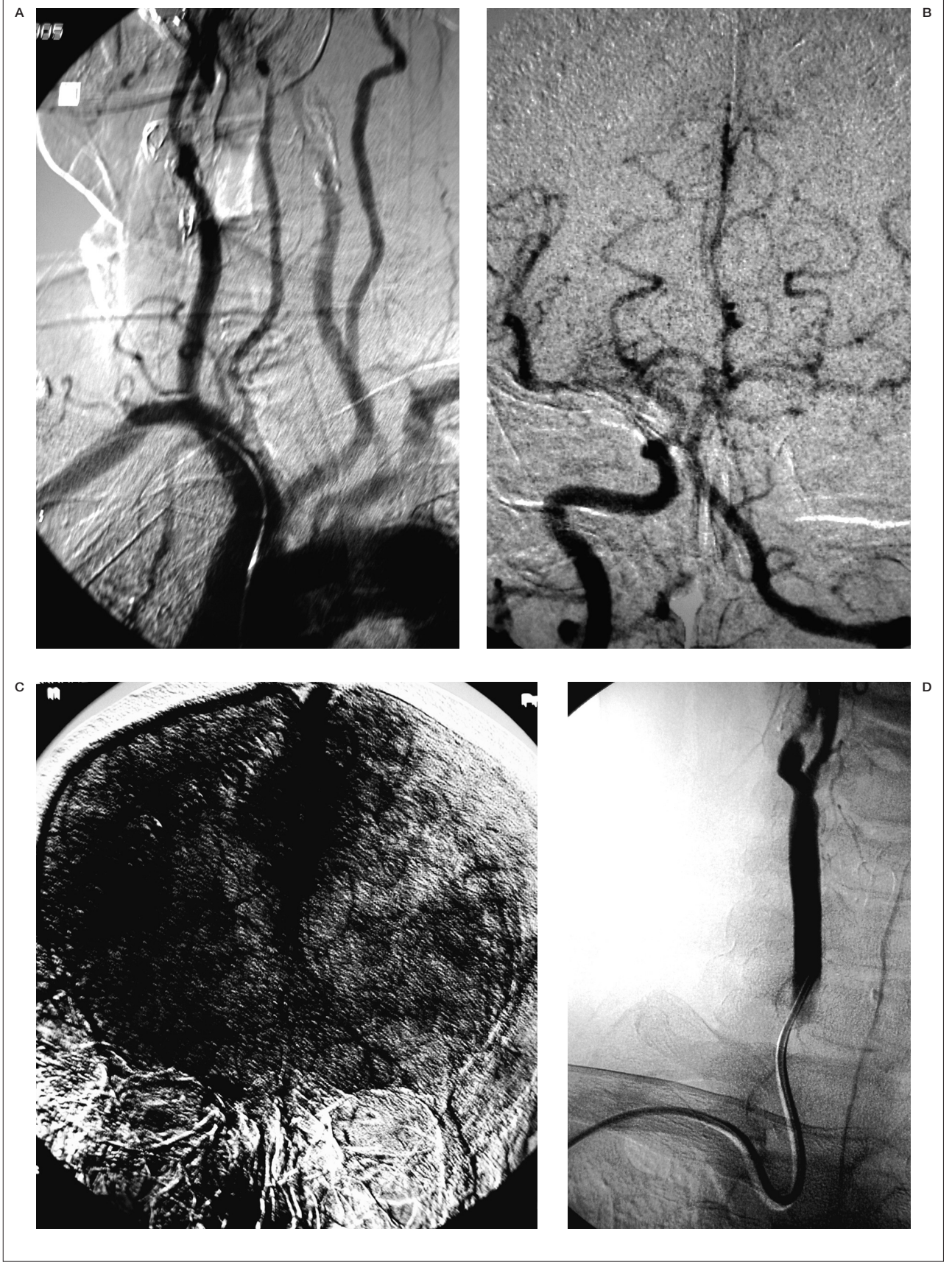
Figure 4 A-H) Ulcerated symptomatic stenosis of the left internal carotid. 69-year-old woman. A) MR angiogram showing an origin of the left carotid unfavourable for a femoral approach. Instead this pattern is favourable for a right radial approach. MR Angiography appears to be a rather good tool for selection of the type of approach. B) Corresponding aortic arch angiogram. C) Catheterization of the left common carotid artery (Simmons 6 french). D) Ulcerated narrow stenosis of the origin of the left internal carotid artery. E) Immediate post protected stenting of the internal carotid artery. F) Intracranial pre-stenting angiogram of the common carotid artery. G) Intracranial post-stenting angiogram showing the obvious hemodynamic improvement of the left hemispheric vascularization. H) patient immediately after the procedure.

sometimes use autoexpandable stents (ZIV5-125-8-6,0) whose advantage is to provide a larger stent diameter stent fitting in a 7 french guiding catheter. We currently prefer to use balloon expandable stents because restenoses seem to be less frequent in this location. However they will need to be positioned without a guiding catheter because a 9 french guiding catheter would have been necessary. We usually use Jomed-Jo stent A2WMZ808 or Cordis Genesis PG2980PPX directly deployed on the road map.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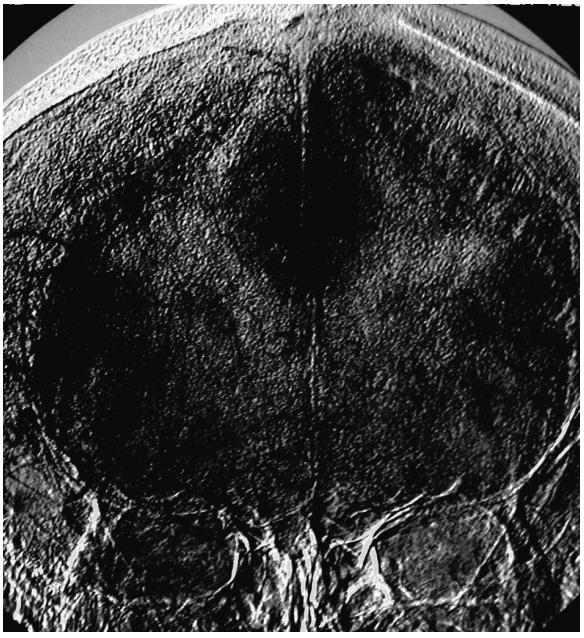

Figure 5 A-G) Multiocclusive lesions of the neck vessels. Mixed origin atherosclerotic and post radiation. Left hemisphere Tias. Right radial approach. A femoral approach was not possible (bilateral occlusive iliac lesions). A) Aortic arch angiogram : occlusion of the left carotid artery, preocclusive stenosis of the internal carotid artery. B) Aortic arch angiogram. AP skull centering. Regular windowing. Arterial phase. This injection shows that the whole brain supply is provided by the left vertebral artery and the stenotic right carotid artery. The right vertebral artery does not participate in the supply to the brain. C) Same injection. Intermediate phase with modification of windowing (digitized parenchymography). Hypovascularization of the left hemisphere (symptomatic side). D) Catheterization of the common carotid artery (Simons 6 french). E) Selective angiogram of the common right carotid artery before stenting. Atherosclerotic and post radiation preocclusive stenosis of the internal carotid artery. F) Same artery. Post stenting angiogram. G) Post-stenting aortic arch injection. Intermediate phase (parenchymography). Significant improvement of the left hemisphere vascularization (compare with C). The patient has not presented Tias since.

Vertebral artery stenoses are less ulcerated than carotid stenoses (less than 5%). The risk of having a complication using current cerebral protection systems, which are not yet adapted to this indication, appears higher than the risk of detaching a particle. We currently do not use a cerebral protection in this indication. So far we have not had any embolic complication. The stents that we use are balloon expandable stents (Medtronic AVE Driver DRV 35018X or DRV40018X).

Results

Significant improvement of the diameter of the dilated artery was obtained in all cases of this series. There were no local or general complications.

Discussion

A) The radial approach appears to be a very useful tool in the management of supraaortic vascular lesions for several reasons:

1) Local complications are very rare. There were none in our series. Femoral complications, more or less significant, are not rare on the type of patients treated and their accompanying treatment including anticoagulants and antiaggregants. As long as the Allen test has been performed the risk of having an ischaemic complication related to the thrombosis of the radial artery is excluded. This is not the case when a brachial approach is performed: the occlusion of the brachial artery, that could potentially occur with the 7 or 8 french catheter necessary for the therapeutic procedures, might jeopardize the entire supply of the hand and forearm.

2) This approach is quite comfortable for the patient who appreciates being able to sit immediately after the procedure. We have never performed carotid stenting on outpatients but this could be more reasonably considered with the radial approach (figure 4).

3) The degenerative displacement towards the right of the vessels arising from the aortic arch makes the most difficult cases via a femoral approach appear easier from the right radial approach because of the more natural curve to be passed (figure 4).

4) The lesions located on the areas of the ascending aorta and the innominate artery are particularly suitable for a radial approach because the femoral approach can be difficult or impossible (figures 2,3).

5) The right radial approach allows treatment of several arteries in the same procedure when needed. The global improvement of the cerebral supply will be readily documented in the course of the same procedure by digitized parenchymography series (18) (figure 5).

6) The remaining impossiblities of performing a radial approach are rare: a) a negative Allen test, b) an anatomical variant (figure 1) at the brachial artery bifurcation: a small caliber does not usually exlude the possibility of doing diagnostic procedures but the use of a 7 french guiding catheter cannot be considered; in this variant and in case of a loop at the origin of the radial artery, the cubital artery approach could be considered.

B) We think that four technical points are critical in this technique and contribute significantly to its success:

1) A Terumo needle puncture set appears quite satisfactory and less traumatic than the other dedicated radial needles.

2) A 6 french Simmons curve diagnostic catheter provides a good aid when performing catheterization in difficult tortuous arteries.

3) A Cook guiding coaxial catheter helps significantly the positionning of the catheter because it makes its navigation much smoother at the origin of the common carotid arteries. This was a significant difficulty with the regular guiding catheters whose origin was frequently slowed down or stopped at this level. We nevertheless keep thinking that the long introducers are not advisable because of the spasm they may induce on the radial artery.

4) The simplest way to select the patients to be treated first intention via a radial approach is, in our opinion, to perform MR angiography. This technique will show the orientation of the origin of the carotid arteries from the aortic arch and will allow selection of the best cases for this approach, especially for the left carotid artery treatments.

Conclusions

For diagnostic and therapeutic procedures involving the supraaortic vessels, the radial approach appears to be a promising technique that any interventionist should have at hand.

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EDITORIAL COMMENT

Jacques Théron has often emphasized the fact that the radial artery approach is widely used by cardiologists for angiographic diagnosis and endovascular procedures.

This is an interesting route of access and all neuroradiologists should know how to access it. A 4F catheter is certainly sufficient for the purposes of neuroradiological angiographic diagnosis, whereas a 5F catheter is preferable for embolization of aneurysms and intracranial endovascular procedures in general.

The 6F should be chosen for carotid artery stenting, while wider diameter catheters will only be required for other larger vessels and are less well tolerated by the brachial approach. Special care and delicacy are of course essential.

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